FLOUR.*

FLOUR may be defined as grains of wheat, separated from the outer husk or covering in which the seed is enveloped, and reduced to a powder. The term "flour," when used without a qualifying word, is understood to be wheaten flour, flour of other grains having the names of the grain prefixed.

We are all familiar with the grain of wheat and its structure, its firmly adherent fibrous coat, with the fine hairs at one end and the germ at the other. Within is a mealy portion composed of a large number of cells, containing principally starch and gluten, with smaller amounts of oil and mineral matter. It is the object of milling to reduce the floury portion of the grain to a fine powder without injuring its physical condition, and, at the same time, excluding all portions of bran and germ which would injure its color and baking properties.

We gain some idea of the magnitude of the miller's task when we consider the size of the grain of wheat. In one bushel we have about 700,000 grains, and in order to obtain 100 pounds of flour, not less than a million and a half of these grains must be treated.

As has been said, the principal substances found in the grain of wheat which are to be excluded from flour are the husk or bran and germ. The fibrous irritating nature of bran and its indigestibility are well known. As to the germ or embryo, we must remember that the grain, except outermost coverings, is a seed, and the germ is the young wheat plant already formed in the seed and only awaiting the proper conditions to sprout. In all seeds provision is made for the nourishment of the embryo until it is so strongly established that it can take care of itself. This store of food is usually in the form of starch, but the young plantlet can only take in its food in the form of mucilage or thin syrup. There is, therefore, associated with the germ a ferment, as it is called, which has the power to convert starch into a mucilaginous product. This power it exerts whenever the seed obtains moisture and warmth. This is well seen in the process of malting, where grains of barley are caused to sprout and then killed by application of dry heat. The starch of barley is found to be largely converted into a syrupy substance.

With the gradual reduction system experience has shown that 135 pounds of wheat yield 100 pounds of flour variously graded, the remaining 35 pounds being cattle feed and waste in milling. Let us now note the composition of wheat, and also flour from same wheat to perceive the changes undergone in milling, and to credit each ingredient with its proper function :

	Wheat ready for rolls.	Flour—straight roller.
Water	9.07	11.83
Ash	1.79	.51
Oil	2.75	1.72
Carb. hydrates	70.37	71.77
Fiber	1.68	.26
Albuminoids	14.35	13.91
	100.00	100.00
Gluten	11.88	

Now, if the germ be allowed to enter the flour, its associated ferment acts upon the starch, producing a sticky mass, with which it is difficult to obtain a light loaf of good color. In the bran, too, there is a ferment which acts in a similar way. Both, therefore, are to be excluded as fully as possible from the flour. * * *

Let us see that we understand the terms used in the analysis. Ash mineral matter, which represents food for formation of bone, is chiefly phosphates. Albuminoids are very valuable ingredients of flour, and consist chiefly of what is called gluten. We may form an idea of the nature of gluten by considering the difference between starch and flour. Starch when moistened with cold water forms a mass which is brittle and crumbles, whereas flour, when so treated, forms an elastic mass. The cause of this elasticity in flour is in the gluten, and wheat is the only one of our cereals containing any notable amount of it. Now, the gluten is the body whose tenacity and elasticity when in the dough enables it to hold the bubbles of gas which are formed in process of rising, and flour deficient in gluten cannot therefrom make a light bread. It follows that gluten is a necessary ingredient of a flour, for some purposes more being required than for others.

But now we come to a point where we can understand the grading of flour. Flour is graded principally on two points, viz., strength and color, the stronger and whiter a flour the greater its value. But what is understood by strength of flour? It is the capacity to produce a well-risen loaf. In other words, a strong flour is one which possesses a large quantity of gluten of good quality; a flour that is not strong is low in percentage of gluten. It so happens that, while gluten is scattered through the entire floury part of the grain, it is present in greatest quantity in the portion next the husk, the very part which is also richest in oil and mineral matter. The outer part of the grain differs from the inner or central part in degree of darkness, so that it is not very difficult for the miller to separate the two portions, and obtain a flour composed principally of the outer part, and another which represents the inner floury portion. In the process of milling the flour from the outer portion becomes more or less contaminated with particles of bran, and is therefore darker in color than that from the interior.

From the roller mills usually three grades of flour are produced in about the following proportion : "Strong baker's," 54 per cent.; "patent," 40 per cent.; "low grade," 6 per cent. The "strong baker's" is the flour from exterior portion of the grain, containing large proportion of gluten, somewhat dark in color on account of presence of branny particles, and also because of comparative high percentage of oil matter. It is used principally by bakers for producing the ordinary brown loaf, its large amount of gluten allowing production of large loaves which may be baked without pans.

"Patent" is the flour from the inner portion of the grain, which contains less gluten than baker's, but is whiter in color. It is used for making finer qualities of bread and for family use, the strong baker's being too strong, forming a mass that offers too much resistance to passage of gas to be suitable for fine pastry.

The "low grade" is a very dark flour, containing very little gluten, but considerable quantities of bran and germ are present. It is not used to any extent in bread-making, but is used in manufacturing and as a food for cattle.

Analysis of "strong baker's" and "patent" will show clearly the difference :

	Strong Baker's.	Patent.
Water	12.18	11.48
Ash	.62	.39
Oil	2.00	1.45
Carb. hydrates	69.99	73.55
Fiber	.33	.18
Albuminoids	14.88	12.25
	100.00	100.00
Gluten	12.00	

I cannot leave this part of my subject without taking up briefly the question of the relative values of graham whole meal, entire wheat flour and white fine flour.

* * * * * * *

Since graham flour is simply the cleaned wheat ground, the analysis of the wheat is, to all intents and purposes, the analysis of graham flour. Let us compare the graham with patent flour :

	Graham.	Patent.
Water	9.07	11.48
Ash	1.79	.39
Oil	2.74	1.45
Carb. hydrates	70.37	73.55
Fiber	1.68	.18
Albuminoids	14.35	12.95
	100.00	100.00
Gluten	11.88	10.85

We find fine flour to contain much less ash mineral matter or bone food, being only one-fifth in quantity and much less fibre. Undoubtedly the fine flour would be a more perfect food did it contain a greater percentage of ash, but other foods supply this in sufficient quantity. Again, we find a higher percentage of albuminoids and gluten in the graham; but it must be kept in view that there is in graham a very much larger amount of fiber, nine times the amount in fine flour. Now this fiber is bran and germ, and the presence of these in graham flour is the weak point of such flour. As already pointed out, in both bran and germ there is a ferment which acts upon the starch and converts it in part into a sticky substance called dextrine. This excess of dextrine, to which is due the sweetness of graham bread, causes the dough to become dark, soft and clammy, on which account the loaf is apt to become sodden and indigestible. Any one who has tried to make a graham loaf knows how difficult it is to obtain a light loaf. The baker's graham is only partly graham.

Another objection to graham flour is the presence of the branny particles, which besides being unpalatable, cause irritation in the alimentary canal, leading to a quicker removal of the but partially digested food.

Taking all things into consideration, it is evident that white bread is really cheaper, weight for weight, to the poor man than the bread made with unbolted flour. Improvements are continually being made in milling, and in the near future it is probable we shall have a fine white flour containing all the nutritious matter of the grain and in the best physical condition.

* From a lecture delivered before the Natural History Society, Montreal, by Prof. J. T. Donald, M.A.

USEFUL INFORMATION

An alloy that expands in cooling, and is suitable for repairing cracks in cast iron, is made with nine parts of lead, two of antimony, and one of bismuth.

According to Le Genie Civil, a French machine tool builder, M. Burot, of Angouleme, is turning out paper pulleys for power transmission, based on the principle of the paper car wheel. The pulleys have metal hubs and arms on which the soft paper mass is mounted and has been compressed. After drying, the paper pulley is heated in a bath of linseed oil and resin to give it greater resistance against the influence of moisture. The pulleys are said to be very light and of low price and to give excellent results in practice.

ALUMINIUM BRONZE.—The Brass Worker says that representatives of the government began a series of experiments to test the strength of aluminium bronze at the Watertown Arsenal, Boston, July 18. It is proposed to use this metal in place of manganese bronze, which is at present in use, and is more expensive. The tensile strength of aluminum bronze proved to be 90,000 pounds to the square inch, and the transverse strength 6,600 pounds to a one-inch square bar. In the first case the strength is in excess of any other metal as far as is known, and in the second case is in excess of everything but the finest crucible steel.

HOW TO CLEAN GUMMY MACHINERY.—The simplest and most efficacious method of thoroughly cleaning the various parts of machinery that have become gummed and dirty by the use of fat oils, for lubricating purposes, is by using a strong soda lye. For each 1,000 parts by weight of water take about 10 to 15 parts by weight of caustic soda or 100 parts ordinary soda. Let the solution boil and enter the parts to be cleaned; either boil them in this lye or let them steep in it for some time. All the dirt and oil resin is completely dissolved thereby, and it remains only to rinse and dry the parts. The action of the lye is such that it enters into combination with the oil and forms soap, which is readily soluble in water. In order to prevent the hardening of the lubricant on the machinery parts, it is only necessary to add about one-third kerosene. An occasional lubricating with kerosene alone is to be recommended.—Glasgow Engineer.

The purest water, according to the *Locomotive*, often is the most active in corroding and pitting plates, and this makes it probable that the active substance in some cases at least, is air. It is well known that water is capable of dissolving a considerable amount of air; in fact, it is this dissolved air that enables fish to breathe. It is not so widely known, however, that the oxygen of the air is more soluble than nitrogen. If a small quantity of water be shaken up in a bottle, it dissolves some of the enclosed air, and when that is afterward driven off by boiling, and analyzed, it is found to consist of oxygen and nitrogen in the proportion of 1 to 1.87, instead of 1 to 4, as in the natural air. Thus, the dissolved air, being more than twice as rich in oxygen as common air is, and being brought into more intimate contact with the metal by means of the water that holds it in solution, exerts a correspondingly more noticeable effect. It is probable, too, that water plays some other important action in connection with the oxidation of metals, for it has been found by recent experiments that pure oxygen will not combine with things that it has the greatest affinity for, providing it is perfectly dry. Even the metal sodium, which has an intense affinity for oxygen, may be heated in it to a very high temperature without combination, [p]rovided sufficient precautions are taken to exclude the slightest trace of moisture. It appears, therefore, that water plays a most important part in the oxidations of metals by air, a part, indeed, that we cannot explain, and that we really know but little about.

A remarkable electrical transmission plant has recently been put down in Nevada, in the Comstock lode and Sutro tunnel. At the Nevada mill there is a 10 foot Pelton water-wheel, supplied by a pipe line delivering water from the side of Mount Davidson under a head of 460 feet, giving 200-horse power. Here the water is caught up, delivered into two heavy iron pipes and conducted down the vertical shaft and incline of the Chollar mine to the Sutro tunnel level, where it is again delivered to six Pelton water wheels, this time running under a head of 1,680 feet. Each of the six wheels is but 40 inches in diameter, weighing 225 pounds; but with a jet of water less than five-eighths of an inch in diameter they develop 125-horse power each. On the same shafts, which revolve 900 times per minute, are coupled six Brush dynamos, which generate the current for the electric motors that drive the stamps in the mill above ground. The result is that, where it took 312 miners' inches of water to operate 35 stamps, but 72 inches are now required to run 60 stamps. This is the greatest head of water ever used by any wheel, and marks an era in hydraulic engineering. A solid bar of iron thrown forcibly against the jet rebounds as though it had struck against a solid body instead of a mobile fluid. The velocity of the jet, where it impinges against the buckets of the wheel, is two miles per minute, 176 feet per second. The wheels weigh only 1.8 pound per electric horse power when working with the maximum head, figures which are only surpassed by the Brotherhood engines used for driving torpedoes, and possibly by the Parsons steam turbine. At the Terni steel works in Italy there is a Girard turbine using water under a head of 1,000 feet, and which we believe is the greatest head used in Europe.

PUBLICATIONS.

Perhaps the ablest critical review that has appeared of late on "Cardinal Newman and the Catholic Reaction" in England is found in Prof. J. T. Bixby's critical paper in the October *Arena*. Prof. Bixby is considered by many competent critics, the ablest magazine contributor, in his peculiar line of thought, in America, and his frequent contributions have done much in placing the *Arena* in its present enviable position as the leading review of progressive, ethical, educational, economic, and religious thought on this continent.